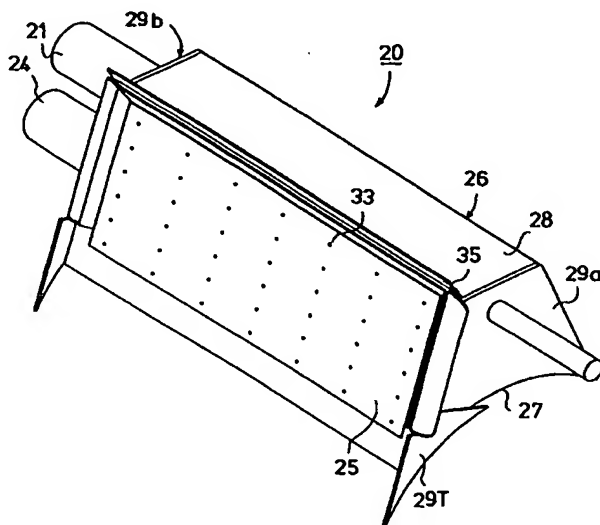




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(21) International Application Number: PCT/FI98/00348 (22) International Filing Date: 20 April 1998 (20.04.98) (30) Priority Data: 971693 21 April 1997 (21.04.97) FI (71) Applicant (for all designated States except US): VALMET CORPORATION [FI/FI]; Panuntie 6, FIN-00620 Helsinki (FI). (72) Inventors; and (75) Inventors/Applicants (for US only): MILOSAVLJEVIC, Nenad [HR/FI]; Ankkurinkyläkatu 13 A 4, FIN-20240 Turku (FI). SAARIKIVI, Pekka [FI/FI]; Kirkkoväärtinkuja 19 as 11, FIN-21200 Raisio (FI). (74) Agent: FORSSÉN & SALOMAA OY; Yrjönkatu 30, FIN-00100 Helsinki (FI).		(81) Designated States: AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published With international search report. In English translation (filed in Finnish).	

(54) Title: BLOW-SUCTION BOX OR EQUIVALENT FOR A PAPER MACHINE OR BOARD MACHINE



(57) Abstract

The invention concerns a blow-suction box or equivalent for a paper machine or board machine, which box (20) comprises at least a pressure chamber (22) and which box (20) is placed in the vicinity of a cylinder, roll, or equivalent, from which cylinder, roll or equivalent a web and/or a wire is/are fitted to run past the box (20). In connection with the pressure chamber (22), a nozzle slot (32) has been arranged, out of which a sealing blowing is fitted to be applied towards the cylinder, roll or equivalent and/or towards the web and/or wire running on its face in order to disintegrate the boundary-layer air flow carried along with the web and/or the wire. In connection with the nozzle slot (32), an air guide (35) made of a resilient material has been fitted in order to direct the sealing blowing and to enhance the sealing further.

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Blow-suction box or equivalent for a paper machine or board machine

5

The invention concerns a blow-suction box or equivalent for a paper machine or board machine, which box comprises at least a pressure chamber and which box is placed in the vicinity of a cylinder, roll, or equivalent, from which cylinder, roll or equivalent a web and/or a wire is/are fitted to run past the box.

10

With respect to the prior art related to the present invention, reference can be made to the *DE Utility Model Publication 29601543*, to the *DE Patent 3910600*, to the *US Patent 5,515,619* and to the *US Patent 4,856,205*, from which publications a mechanical seal is known which is used in connection with a blow-suction box or equivalent, which is in contact with, or in a near proximity of, a wire or equivalent, and which seals the closing nip between the box and the adjacent cylinder in order to cut off a boundary-layer air flow. A boundary-layer air flow follows a paper web and a wire when they come from a drying cylinder towards a reversing cylinder or roll. In the prior-art solutions, the seal is mechanical and often also rigid, in which case it may damage the wire coming from the cylinder, or it can be broken itself. These physical seals can be broken as a result of prolonged operation, and, moreover, owing to deterioration or damaging of a seal, the capacity of blow-suction boxes is lowered considerably in paper machines.

25 One problem in the prior-art blow-suction boxes has been the problems of runnability as air is pumped through the wire in a nip, which results in separation of the web from the wire and, at the same time, causes wrinkles and bag formation.

One object of the present invention is to provide a solution in which the problems mentioned above have been eliminated or at least minimized.

30

With respect to the prior art, reference is also made to the *applicant's FI Patent No. 80,491 (equivalent to US 4,905,380)*, in which a method and a dryer group in a multi-cylinder dryer in a paper machine are described, in whose connection a blow-suction box is employed which includes a suction and/or closing compartment, by
5 whose means the upper free sectors of reversing cylinders between the adjacent wedge spaces have been covered. In the gaps between drying cylinders, said combined blow-suction boxes are placed, which have a plane wall at the inlet side of the drying wire and of the web, into whose edge a nozzle opening or openings is/are opened, by whose means a flow is blown which ejects in the direction opposite to
10 the direction of movement of the drying wire placed facing said nozzle opening(s), by means of which flow a field of vacuum is induced in the gap space between said wall and the straight run of the drying wire and the web as well as in the following wedge space. An object of the present invention is further development of the blow-suction box so that the effects of the boundary-layer air flow are eliminated and that
15 the effect achieved by means of the blow-suction box on the support and runnability of the paper is improved.

As is known from the prior art, multi-cylinder dryers in paper machines usually consist of two horizontal rows of drying cylinders placed one row above the other,
20 between which the paper web runs meandering. In connection with the drying cylinders, currently, drying wires permeable to air are employed. In the dryer section of a paper machine, single-wire draw and/or twin-wire draw is/are employed. Single-wire draw is understood as a draw in which the web runs from one drying cylinder onto the other on support of one and the same drying wire also
25 between the rows of cylinders. In twin-wire draw, in which an upper wire and a lower wire are employed, the web has free unsupported draws when it runs from one row of cylinders to the other. The present invention is suitable for use most advantageously in applications with single-wire draw.

30 The blow-suction box or equivalent in accordance with the present invention for a paper machine is mainly characterized in that, in connection with the pressure chamber, a nozzle slot has been arranged, out of which a sealing blowing is fitted to

be applied towards the cylinder, roll or equivalent and/or towards the web and/or wire running on its face in order to disintegrate the boundary-layer air flow carried along with the web and/or the wire, and that, in connection with the nozzle slot, an air guide made of a resilient material has been fitted in order to direct the sealing blowing and to enhance the sealing further.

In accordance with the invention, the effects of the boundary-layer air flow are eliminated by cutting off the boundary-layer air flow by means of a blow-suction box or by means of an equivalent combined air-sealing blowing. The sealing blowing prevents pumping of air into the nip. In connection with the sealing-blowing nozzle, favourably a mechanical, resilient air guide has been fitted, which extends to a distance from the wire or equivalent and which, thus, yields resiliently in the event of a possible wire contact, and, at the same time, the air guide provides aid in directing of the sealing blowing. By means of sealing blowing, the gap between the blow-suction box or equivalent and the wire/cylinder or equivalent can be sealed so that the boundary-layer air flow does not cause problems of runnability or other problems.

In accordance with the invention, in the top portion of the blow suction box, a narrow nozzle has been fitted, below which an air guide has been fitted. The air guide is made of a resilient material, e.g. plastic, rubber or of a fabric, and it is not in direct contact with the wire or equivalent. The distance between the air guide and the wire or equivalent is, for example, 5...10 mm. The air guide directs and supports the sealing blowing and divides the areas of the suction zone and the sealing-blowing zone in the blow-suction box and, at the same time, the air guide prevents loss of the sealing air partly by the effect of the suction effect of the suction zone.

According to a preferred additional feature of the invention, the face of the blow-suction box following after the sealing-blowing nozzle is corrugated. The corrugated face produces microturbulence in its valley areas, in which case the removal and elimination of the boundary-layer air flow are enhanced. The valley areas in the

corrugated face are provided with suction openings, through which the suction effect is produced. The pressure in the box and the support of the paper can be controlled by choosing the holes that are used in the desired way.

- 5 One object of the corrugated face is to reduce the volume of the suction zone area, in which case it is possible to suck small amounts of air in order to produce a suitable vacuum and to keep the paper web in contact with the wire. By means of a corrugated face, the suction area is automatically divided into an area formed by a number of smaller zones, in which case the keeping of the paper on the wire is
10 controlled by sucking air out of each zone. In this way the paper remains on the wire evenly. The peaks in the corrugated face do not extend up to the wire, and the distance from the top of a wave to the wire is, for example, 5...10 mm, and, if necessary, in connection with the corrugated face, in order to guide the wire, wire guide devices are fitted in connection with said walls.

15

A blow-suction box in accordance with the invention also enhances the operation of a lower reversing cylinder or roll, because, for its own part, it also eliminates air flows that are detrimental to the operation of said lower cylinders or rolls.

- 20 According to a favourable additional characteristic feature of the invention, sealing blowing in accordance with the invention has been arranged at each side of the box.

- According to a favourable embodiment of the invention, it is also possible to reduce the consumption of energy by applying ideas in accordance with the present invention
25 tion in connection with a what is called box for a whole pocket, a box of said sort being described, for example, in said *FI Patent No. 80,491 (equivalent to US Pat. 4,905,380)*.

- In the following, the invention will be described in more detail with reference to the
30 figures in the accompanying drawing, the invention being in no way supposed to be strictly confined to the details of said illustrations.

Figures 1A...1C are schematic illustrations of an exemplifying embodiment of the invention.

Figures 2A...2C are schematic illustrations of a second exemplifying embodiment of the invention.

Figure 3 is a schematic illustration of a further exemplifying embodiment of the invention.

10 As is shown in Figs. 1A...1C, the blow-suction boxes 20 comprise an upper wall 28 and side walls 25 and 26 as well as a lower wall 27 and vertical end walls 29a and 29b, which end walls have curved bottom edges 29V complying with the outer face of the reversing cylinder or roll 14, which bottom edges are placed at the distance of a gap V from the mantle 18. In connection with the bottom edge 29V, there may
15 be edge seal ribs 29T if necessary. The side walls 25 and 26 are placed at the distance of a gap T from the adjacent cylinders 15,16, respectively, and from the web W and the wire F.

The blow-suction box 20 includes a pressure chamber 22, into which the air is
20 passed through the duct 21. Out of the compartment 22, a sealing blowing is directed through the nozzle slot 32 of the box 20 towards the adjacent cylinder 15. The side wall 25 placed below the sealing-nozzle slot 32 is made of a perforated sheet, in which perforated sheet the holes 33 form the suction openings 33, by whose means a vacuum is produced in the intermediate space T, and in such a case
25 a vacuum is effective in the chamber part 23, and by means of the vacuum produced through the holes 33 and effective in the space T, keeping of the web W in contact with the wire F is secured, and elimination of the boundary-layer air flow zone is enhanced partly further. Out of the vacuum chamber 23, air is removed and the vacuum is produced through the duct 24.

30

Below the nozzle slot 32, as the bottom wall of the nozzle, an air guide 35 has been fitted in order to direct the sealing blowing and to enhance the sealing further. The

distance between the tip of the air guide 35 and the wire F / cylinder 15 is, for example, 5...10 mm, and the air guide 35 is made of a resilient material, for example rubber, plastic, a fabric, or equivalent, so that, in the event of a possible wire contact, the air guide 35 bends.

5

The exemplifying embodiment of the invention illustrated in Figs. 2A...2C is substantially similar to that illustrated in Fig. 1, and the same reference numerals represent corresponding parts. In this embodiment of the invention, the side wall 25 placed below the nozzle slot 32 for the sealing blowing at the box 20 is provided with a corrugated face 41, and the holes 33 passing into the vacuum chamber 23 are placed in the valley areas 42 in said corrugated face 41. By means of the corrugated face 41, the disintegration of the boundary-layer zone is enhanced further, and the runnability and the holding of the web W on the wire F are improved, because air vortexes are formed in the valley areas 42 of the corrugated face 41. The distance between the wave tops and the adjacent wire/cylinder is, e.g., 5...10 mm.

The exemplifying embodiments of the invention shown in Figs. 1A...2C have been accomplished preferably with a blow-suction box that applies the principle of a what is called box for a whole pocket, which box occupies a substantial area of the pocket space between two adjacent cylinders 15,16 and the reversing roll or cylinder 14 placed below said cylinders.

In the exemplifying embodiments shown in Figs. 1A...2C, between the lower wall 27 and the reversing roll 14, there can be a what is called labyrinth seal, a seal of said sort being described, e.g., in the *Applicant's US Patent 5,509,215*, or some other seal of a suitable type.

In addition to what has been shown in Figs. 1A...2C, the other upper corner of the pressure compartment in the blow box may also be provided with an air-sealing nozzle slot if it is desirable to produce a nozzle flow at this side in order to guide the boundary-layer air flow, of which an exemplifying embodiment is illustrated in

Fig. 3. Also in the other respects, the construction of this side can be similar to the construction of the other side, fully or partially.

The exemplifying embodiment of the invention illustrated in Fig. 3 is substantially
5 similar to the exemplifying embodiments shown in the preceding figures, and
corresponding parts are denoted with the same reference numerals. In this embodi-
ment of the invention, sealing blowings at the box 20 have been accomplished at
both sides of the box 20 so that the sealing blowing is directed from the nozzle
opening 32 of the pressure compartment 22 towards the adjacent cylinder 15, and
10 similarly from the nozzle opening 32B towards the adjacent cylinder 16. In connec-
tion with each nozzle opening 32,32B, a mechanical air guide 35,35B has been
fitted. The arrows shown in the figure indicate the sealing blowings T,TB and the air
flows P produced by the vacuum chamber 23. In the exemplifying embodiment
shown in Fig. 3, seals 25T,26T in the cross direction of the machine have also been
15 fitted at each side in connection with the side walls 25,26 of the box 20.

The exemplifying embodiments shown in the figures are so-called boxes for a whole
pocket, but the invention is also suitable for use in connection with blow boxes or
equivalent of different types.

20

Above, the invention has been described with reference to some preferred exemplify-
ing embodiments of same only, the invention being, however, not supposed to be in
any way strictly confined to the details of said embodiments. Many variations and
modifications are possible within the scope of the inventive idea defined in the
25 following patent claims.

Claims

1. A blow-suction box or equivalent for a paper machine or board machine, which box (20) comprises at least a pressure chamber (22) and which box (20) is placed in the vicinity of a cylinder, roll, or equivalent (15), from which cylinder, roll or equivalent (15) a web (W) and/or a wire (F) is/are fitted to run past the box (20), **characterized** in that, in connection with the pressure chamber (22), a nozzle slot (32) has been arranged, out of which a sealing blowing is fitted to be applied towards the cylinder, roll or equivalent (15) and/or towards the web (W) and/or wire (F) running on its face in order to disintegrate the boundary-layer air flow carried along with the web (W) and/or the wire (F); and that, in connection with the nozzle slot (32), an air guide (35) made of a resilient material has been fitted in order to direct the sealing blowing and to enhance the sealing further.
2. A blow-suction box or equivalent as claimed in claim 1, **characterized** in that the box (20) further comprises a vacuum chamber (23), at which the side wall (25) of the vacuum chamber (23) placed at the side of the nozzle slot (32) is provided with holes (34) so as to produce a vacuum effect in the space between the box (20) and the adjacent web (W) and/or wire (F), in particular in a closing nip space (T).
3. A blow-suction box or equivalent as claimed in claim 2, **characterized** in that, in connection with the side wall (25), a corrugated face (41) has been provided in order to further enhance the disintegration of the boundary-layer air flow.
4. A blow-suction box or equivalent as claimed in claim 2 or 3, **characterized** in that the holes (33) in the side wall (25) that pass into the suction chamber (23) in the box (20) are placed in the valley areas (42) of the corrugated face (41).
5. A blow-suction box or equivalent as claimed in any of the claims 1 to 4, **characterized** in that, for sealing blowing, a second nozzle slot has been provided at the opposite side of the box (20), at the side of the other adjacent cylinder, roll or equivalent (16).

6. A blow-suction box or equivalent as claimed in any of the claims 1 to 5, characterized in that the blow-suction box (20) is a blow-suction box or equivalent, a what is called box for a whole pocket, which occupies substantially the whole of the pocket space defined by two adjacent cylinders (15,16) and by the reversing roll (14) placed below them as interlocking with them and by the web (W) and/or the wire and which is placed at the distance of the necessary safety gaps (T,V).

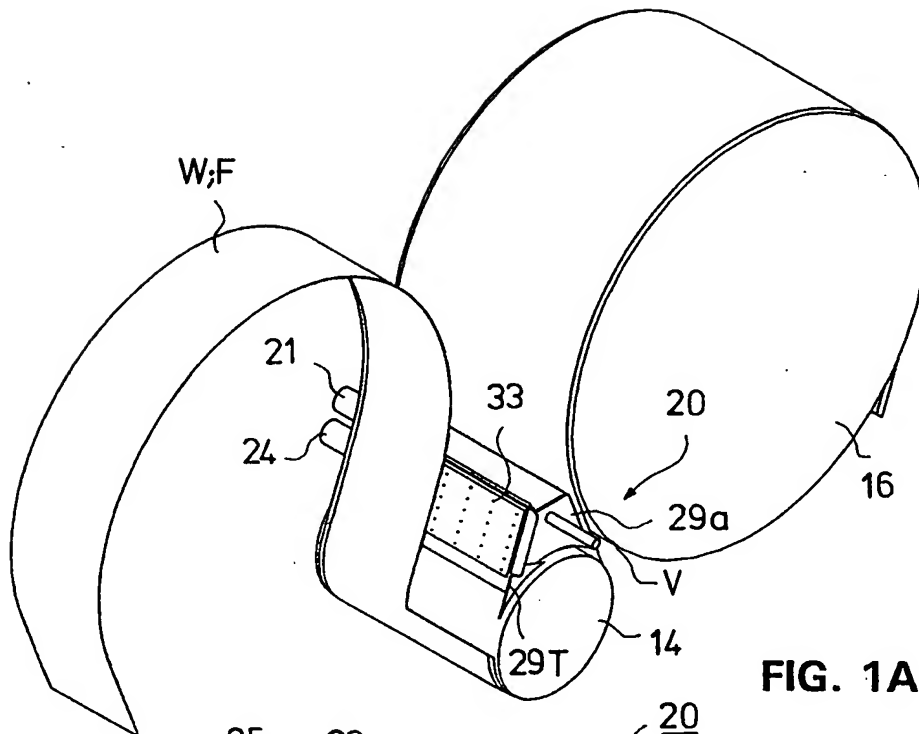


FIG. 1A

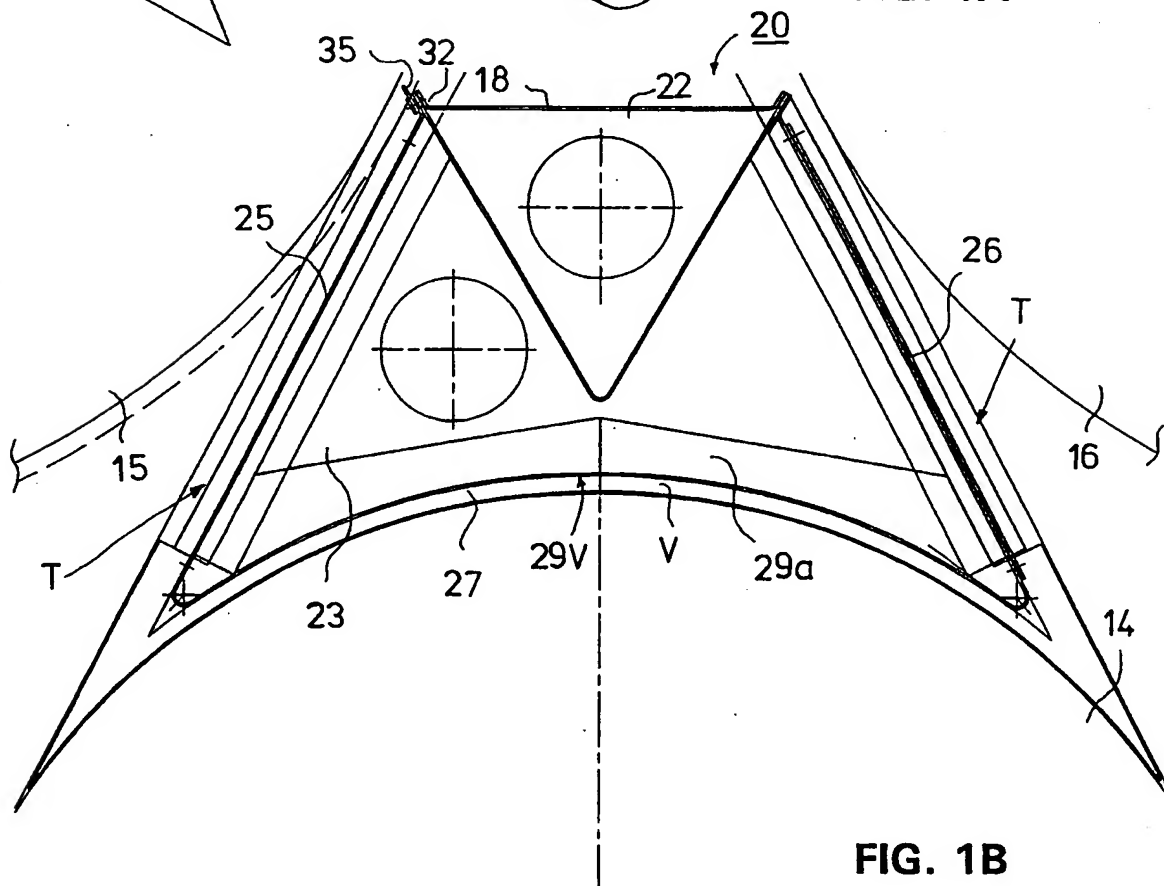


FIG. 1B

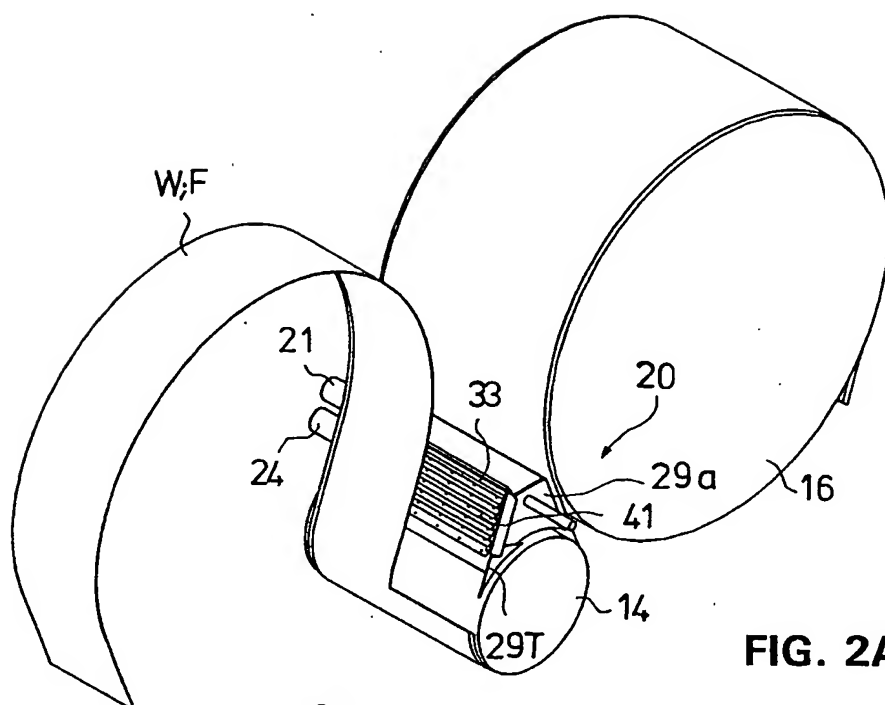


FIG. 2A

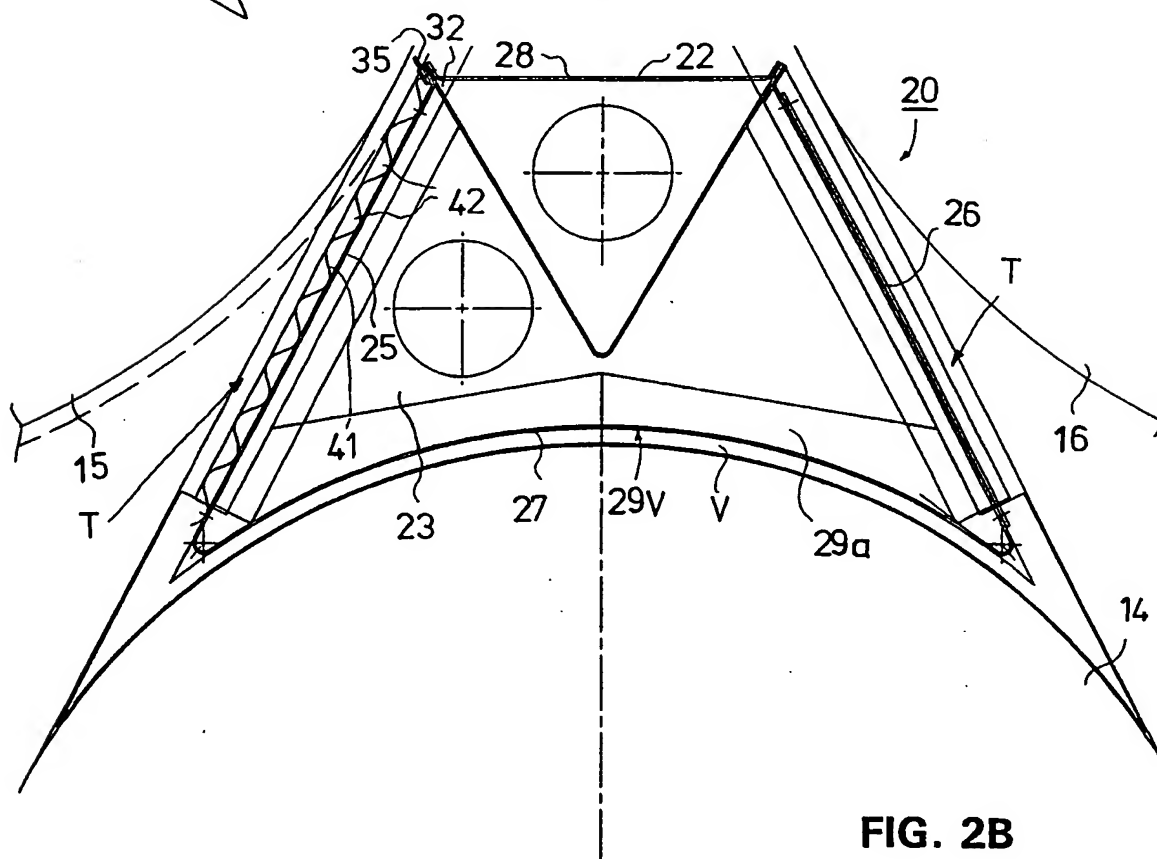


FIG. 2B

3/4

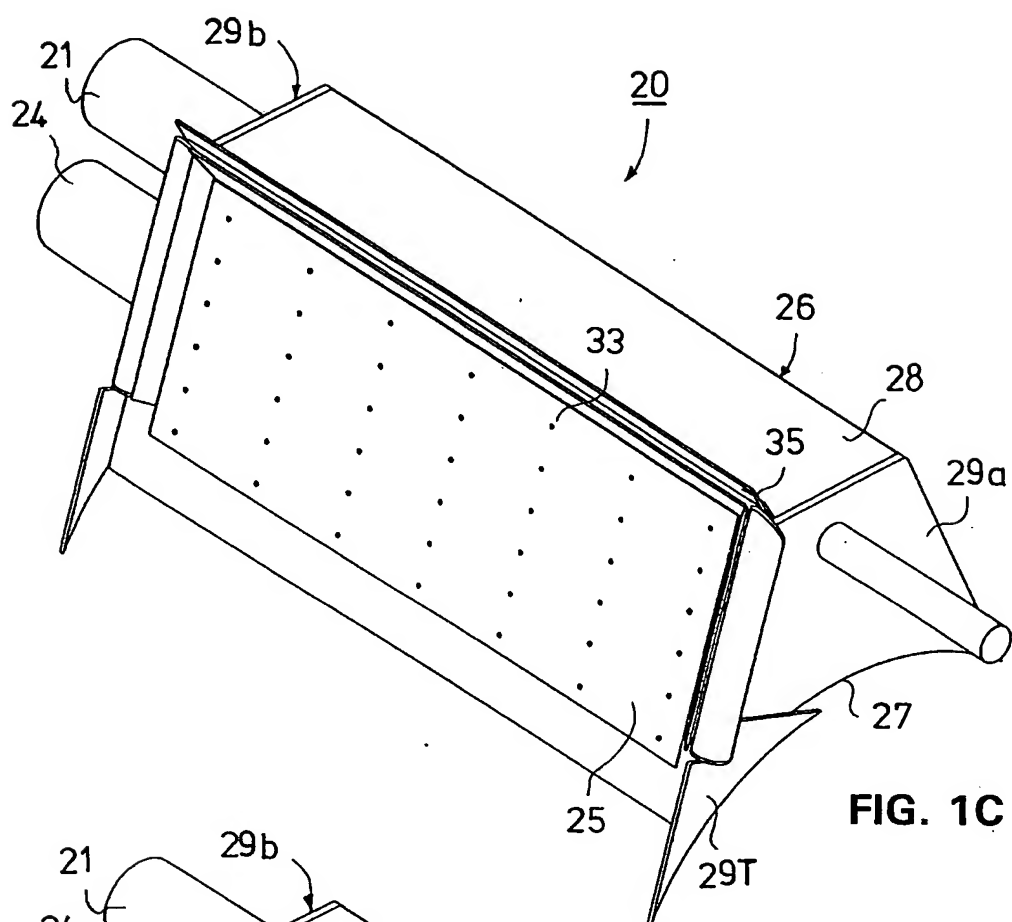


FIG. 1C

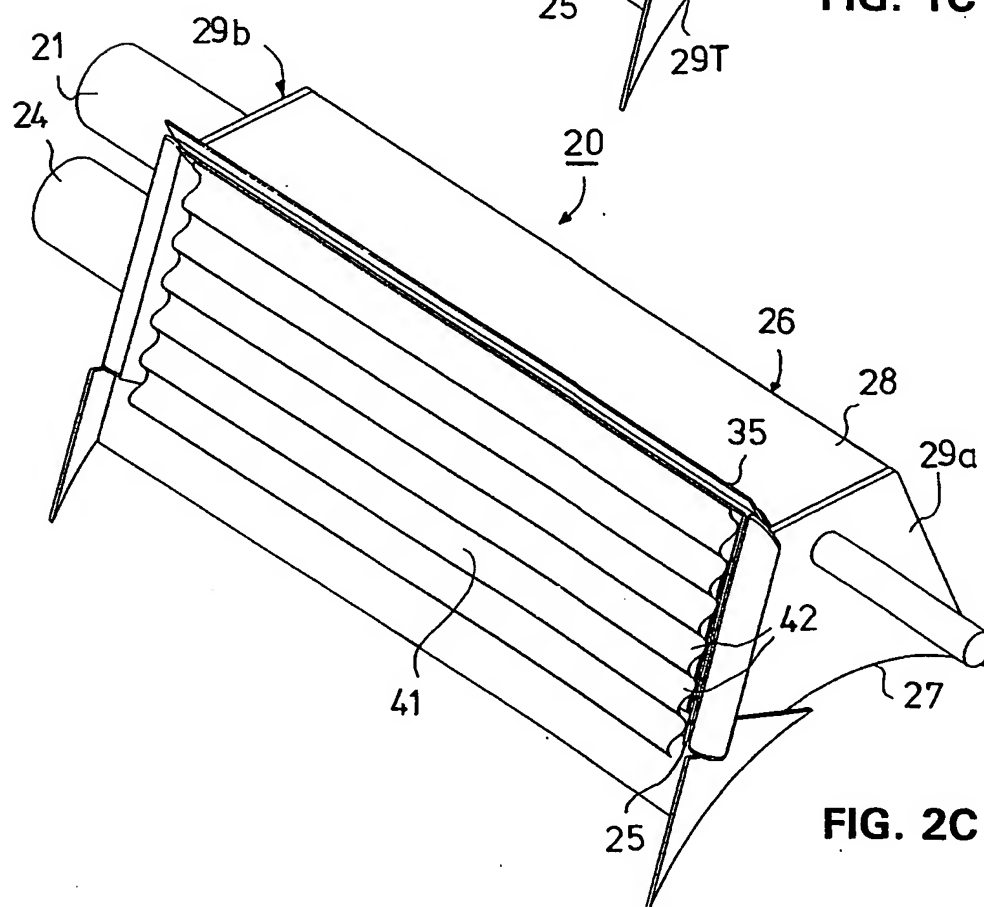


FIG. 2C

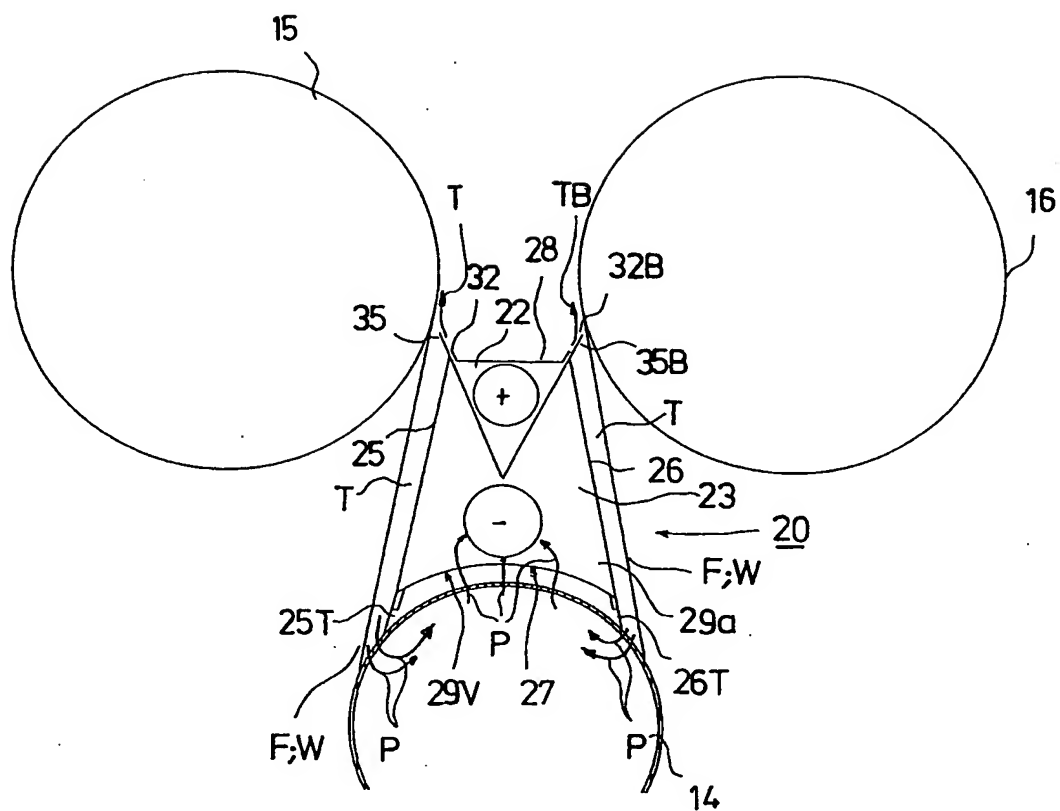


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI 98/00348

A. CLASSIFICATION OF SUBJECT MATTER		
IPC6: D21F 5/04 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
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C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4899463 A (HEIKKILÄ ET AL.), 13 February 1990 (13.02.90), figures 1-3, abstract --	1,5,6
Y	US 5477624 A (HAESSNER ET AL.), 26 December 1995 (26.12.95), column 4, line 25 - line 39, figures 1-7, abstract --	1,5,6
A	US 5341579 A (SCHIEL ET AL.), 30 August 1994 (30.08.94), figures 1-6, abstract --	1,2
A	US 4441263 A (VEDENPÄÄ), 10 April 1984 (10.04.84), column 5, line 26 - line 28, figures 1-8, abstract --	1,2,6
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
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INTERNATIONAL SEARCH REPORT

Information on patent family members

09/06/98

International application No.

PCT/FI 98/00348

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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